Introducing bryophytes

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Bryophytes are small but beautiful plants. They are frequently overlooked yet are vital components of most ecosystems. Bryophytes are early colonizers after disturbance e.g. by fire (Fig. 1), protecting the bare soil and nutrient-rich ash from wind and water erosion, and providing a moist bed for seed germination of vascular plants. They contribute to nutrient cycling, provide shelter and protection for invertebrates – and thus harbour a food source for a wide variety of animals – and provide nesting material for birds and cocoon-forming insect larvae. They have been used as bioindicators and biomonitors of environmental pollution as well as phytoremediators, and a number of them have antifungal and antibacterial properties. In spite of all this, relatively little is known of bryophyte ecology or, indeed, what occurs where.

This special issue of *The Victorian Naturalist* highlights some of the current investigative work being done in Victoria. Papers included in this issue consider the soil crusts of the Little Desert National Park and their associated invertebrates, a comparison of the epiphytic bryophytes of Myrtle Beech with those of Mountain Ash, the bryophytes of Cool Temperate Rainforest, and bryophytes of stream rocks.

Bryophytes are divided into three groups, the mosses, liverworts and hornworts. None of them has roots; instead, they attach to their substratum by rhizoids which do not take up nutrients as roots do. Bryophytes take up nutrients dissolved in water directly through the plant body. Mosses have stems and leaves (Fig.2), while liverworts consist of stems and leaves or a thallus consisting of flattened

Fig. 1. *Funaria hygrometrica*, a moss, forms thick carpets after fire, protecting the ash bed from erosion and providing a moist habitat for regeneration of other plants. The photograph was taken at Wilsons Promontory, approximately six months after the easter bushfire.

green strap-like or lobed structures (Figs. 3 and 4). Moss leaves often have a vein (costa) running down the centre. Leafy liverworts never have a costa. The leaves of both mosses and liverworts usually are one cell in thickness, although some mosses have more cell layers, especially around the costa. Liverwort leaves are often two-lobed, with each lobe growing from two distinct apical points. Most moss species have leaves arranged around the stem in a spiral. Leafy liverworts have leaves arranged in rows; many have two rows of lateral leaves and a row of smaller leaves on the undersurface. Mosses have multicellular rhizoids; liverworts have unicellular rhizoids.

Hornworts are thallose, so superficially resemble thalloid liverworts, but many features distinguish the two. Each hornwort cell usually has only one large chloroplast, but liverwort cells have many small discoid chloroplasts. Hornworts have stomata but liverworts do not. These features, however, are difficult to see in the field. Hornworts are often rosette-like and one to two centimetres across. Usually they have many internal cavities filled with mucilage, which can be seen with a handlens by slicing through the hornwort and looking at the cut edge. In liverworts such cavities are air filled.

Many other features can be used to distinguish the three groups of bryophytes. Most of these require microscopic analysis, but with a little practice it is surprising how quickly one intuitively recognizes whether a bryophyte is a moss, liverwort or hornwort. Identifying a bryophyte to genus or species level is more difficult. Over the last ten years, the increased production of beautifully illustrated field guides with many accompanying photographs has helped greatly, but photographs frequently are insufficient to distinguish a bryophyte to either genus or species level. The serious student of bryophytes requires simple, easy-to-use keys. This issue of *The Victorian Naturalist* presents several keys, one to the genera (and many species) of leafy liverworts, one to the thallose liverworts and hornworts and one to the moss genus *Fabronia*. The paper dealing with *Fabronia* also includes a discussion on its affinities and conservation status.

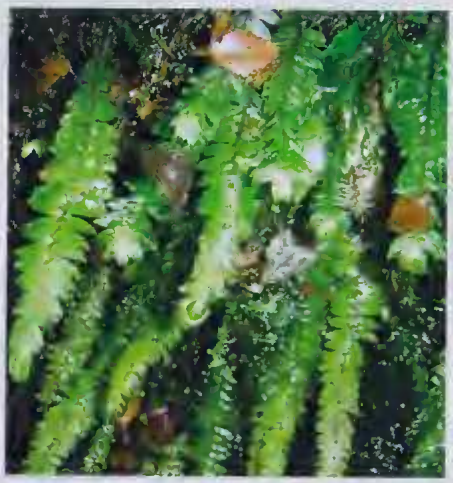

Fig. 2. *Cyathophorum bulbosum*, a moss with a leaf arrangement common in leafy liverworts, i.e. two lateral rows of leaves and a row of smaller leaves on the undersurface (not shown).

Fig. 3 *Marchantia berteroana*, a common thalloid liverwort.

Fig. 4. *Hymenophyton flabellatum*, a stalked thallose liverwort common in wet forests.

Bryophytes can reproduce sexually and asexually (without sex). Asexual reproduction is generally vegetative and includes fragmentation with subsequent growth of the fragment into a new plant, development of specialized structures such as gemmae, which grow into new individuals, and new growth of shoots that develop rhizoids and become independent following degeneration of older parts. Sexual reproduction involves an alternation of generations (Fig. 5). The green plant normally recognized as the bryophytie plant is the gametophyte generation, which produces the gametes, that is, the eggs (ova) and sperm (antherozoids). Fertilization of the egg results in development of the second generation, called a sporophyte, which produces the capsule that contains spores. Sporophyte cells have twice the chromosome (genetic material) component of the gametophyte. Within the capsule a process called meiosis occurs, resulting in development of spores that have half the chromosome complement of the sporophyte. Upon release and dispersal to a suitable habitat, the spores germinate and develop into another gametophyte generation. This basic cycle occurs in all three groups of bryophytes but each group has its own variations; for example, most mosses have a filamentous stage of the gametophyte, called the protonemal stage, which produces buds that grow into leafy plants with rhizoids. In liverworts, the protonemal stage is reduced and each protonema produces only a single plant. Protonema do not occur in hornworts. Sporophytes easily distinguish the bryophyte groups from each other but, inconveniently, are not always present. Some species never produce sexually so never produce a sporophyte. Other species may reproduce sexually in one region but not another. Studies on the sexual reproduction of bryophytes are comparatively few worldwide but are particularly rare in Australia. This issue presents an investigation of the sexual reproduction of *Atrichum androgynum*, a common moss of wet forests in Australia.

Also included in this issue is a paper dealing with the bryophyte collection of the National Herbarium of Victoria. This paper provides a historic timeline of the collections and provides details on some of the more significant collectors.

This landmark issue of *The Victorian Naturalist* showcases some of the research occurring throughout Victoria and should encourage others to look at the many and varied aspects of bryophyte taxonomy and ecology. Hopefully, this will be reflected in an increase in the publication rate of bryological papers in *The Victorian Naturalist*.

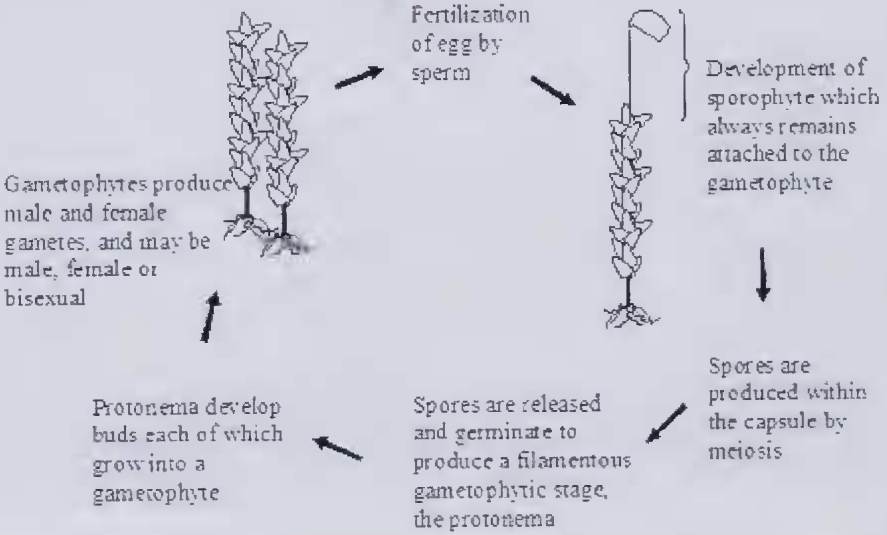

Fig. 5. Basic alternation of generations in a moss.